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Research area: General aims

Environmental technology // Water

Key words:

Cross-sector approach, water and energy savings, paper, wet exhaust air, membranes, technologies, less water less energy

Title:

EU-CapWa – Capture of evaporated water with novel membranes

Background/Problem area

One of the major challenges of this century is the provision of safe drinking water for a growing population. In contrast high quality water is needed for many industrial processes (e.g. steam generating process). In order to achieve this high quality water, raw water needs to be treated and demineralised. This treatment process can be very laborious and costly depending on the raw water source. However, even in water rich countries like Germany, authorities put limits on drinking-water use for industrial purposes. The shortage in water resources, especially in arid areas requires the availability of new, environmental friendly technologies with a high economic and social impact.

In contrast there are large quantities of water vapour present in the air produced and/or liberated in industrial processes and escaped as “waste” water to the atmosphere. Currently, there is no evaporated “waste” water recovery from industrial processes. In principle it is possible to recover water from wet exhaust air (e.g. flue gas, exhaust air of a paper machine) by condensation with a heat exchanger. But cooling the gas stream, or part of it, has a high energy and cooling demand.

Using gas separation membranes, one is able to recover the water and, with a sufficiently selective membrane, produce purified water in a single process step. Because water is removed, the dew point of the exhaust air stream will decrease and energy can be recovered as well, increasing the overall efficiency of an industrial process. This efficiency improvement can be translated to fuel savings and as a consequence reduction of CO_2 emission.

Objectives/Research results

The objective within CapWa is to produce a commercially available membrane modular system suitable for industrial applications. The concept of this membrane is based on a gas separating composite membrane capable of capturing evaporated “waste” water. The objective within this project is to transfer the technology from lab scale to industrial scale.

First step was a lab scale testing of the membrane system in the exhaust air stream of a paper machine hood. The produced water quality from this system is comparable with the quality of demineralised water.

Within the planned pilot plant experiments the behaviour of the membrane system with respect to the thermal/chemically stability under the existing environmental conditions and the resistance to fouling are tested.

Application/Economic benefits

A proof of principle of this concept has been achieved in the flue gas ducts of coal-fired power plants and a waste-to-energy plant. The advantages of the proposed process compared to traditional molecular separation are:

- High energy efficiency: no phase change is required to achieve separation
- Temperature neutral to the source: making heat recirculation in industrial processes very interesting
- Reliability: no moving parts
- Small foot print: it generally easily fits in existing spaces, factories etc.
- Environmental friendly: little to no use of chemicals, no waste streams

Currently on-site pre-trials in the exhaust air of a paper machine hood are being prepared. Simulation studies with different modelling tools will be used to support and speed up the development of the end user system. This includes also predicting the impact of different integration concept by ensuring water quality, product quality and process stability.

Period of time: 01.09.2010 – 31.08.2013

Remarks

The integrated research project CapWa (EU-FP7-SME CP-FP 246074-2) is being funded by the European Commission (FP 7). The project is coordinated by KEMA in cooperation with 13 partners from five European and three African countries:
4 industrial partners representing end users as model companies
4 industrial partners representing membrane technology suppliers (global player enterprises and SME),
3 institutes, and 3 universities.